



**FinalDraft**

**Record of Decision/  
Final Remedial Action Plan  
for Installation Restoration Site 21**

**Naval Station Treasure Island  
San Francisco, California**

**~~February 7~~May 20, 2012**

Prepared by:

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Prepared under:

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### **Attachments**

- A Applicable or Relevant and Appropriate Requirements
- B Responsiveness Summary
- C References (Reference Documents Provided on CD Only)
- D Administrative Record Index (Administrative Record Provided on CD Only)
- E Public Meeting Notice and Public Meeting Transcript
- F Statement of Reasons
- G Proposed Plan/Draft RAP

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## ACRONYMS AND ABBREVIATIONS

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µg/L	Microgram per liter
§	Section
ARAR	Applicable or relevant and appropriate requirement
bgs	Below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of concern
COPC	Chemical of potential concern
COPEC	Chemical of potential ecological concern
CRUP	Covenant to Restrict Use of Property
CTE	Central tendency exposure
DCE	Dichloroethene
DTSC	Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
FFS	Focused feasibility study
GRA	General response action
HHRA	Human health risk assessment
HI	Hazard index
HQ	Hazard quotient
IC	Institutional control
IR	Installation Restoration
ISB	In situ bioremediation
LUC RD	Land use control remedial design
MOA	Memorandum of Agreement
NAVSTA TI	Naval Station Treasure Island
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OEHHA	Office of Environmental Health Hazard Assessment
O&M	Operation and maintenance

## ***ACRONYMS AND ABBREVIATIONS (Continued)***

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PA	Preliminary assessment
PCE	Tetrachloroethene
PRB	Permeable reactive barrier
PRG	Preliminary remediation goal
RAB	Restoration Advisory Board
RAO	Remedial action objective
RAP	Remedial action plan
RI	Remedial investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SI	Site inspection
SLERA	Screening-level ecological risk assessment
SVOC	Semivolatile organic compound
SWRCB	State Water Resources Control Board
TCE	Trichloroethene
TI	Treasure Island
TPH	Total petroleum hydrocarbons
VOC	Volatile organic compound
Water Board	San Francisco Bay Regional Water Quality Control Board
YBI	Yerba Buena Island

## 1. DECLARATION

This Record of Decision/Final Remedial Action Plan (ROD/Final RAP) presents the remedy selected by the Navy for Installation Restoration (IR) Site 21 (Site 21), the former Vessel Waste Oil Recovery Area, at the former Naval Station Treasure Island (NAVSTA TI), in San Francisco, California. The remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Title 42 *United States Code* Section [§] 9601, et seq.), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 *Code of Federal Regulations* [CFR] Part 300). Site 21 has not been placed on the CERCLA National Priorities List. The CERCLA Information System identification number is CA7170023330. This ROD/Final RAP includes seven attachments:

- A: [Applicable or Relevant and Appropriate Requirements](#)
- B: [Responsiveness Summary](#)
- C: [References](#)
- D: [Administrative Record Index](#)
- E: [Public Meeting Notice and Public Meeting Transcript](#)
- F: [Statement of Reasons](#)
- G: [Proposed Plan/Draft RAP](#)

The California Environmental Protection Agency (Department of Toxic Substances Control [DTSC]) and the San Francisco Bay Regional Water Quality Control Board [Water Board]) concur with the selected remedy. The decision documented in this ROD/Final RAP is based on and relies on the Administrative Record<sup>1</sup> file. Information that is not specifically summarized in this ROD/Final RAP or its references but that is contained in the Administrative Record has been considered and is relevant to the selection of the remedy at Site 21.

The Navy provides funding for site remediation at Former NAVSTA TI under the Base Realignment and Closure (BRAC) program. The Federal Facility Site Remediation Agreement for Former NAVSTA TI documents how the Navy intends to meet and implement the requirements of CERCLA in partnership with DTSC and the Water Board. Although not a signatory agency, the U.S. Environmental Protection Agency (EPA) has reviewed all major documents and concurs with the selected alternative.

Investigations into the release of hazardous substances, hazardous waste petroleum constituents, and other regulated substances began at Site 21 NAVSTA TI in 1988. A final Remedial Investigation (RI) Report was completed in 2007, and a Final Focused Feasibility Study (FFS) Report was completed in 2009. This ROD/Final RAP documents the final remedial action for Site 21.

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<sup>1</sup> **Blue text** identifies detailed site information available in the Administrative Record and listed in the References Table ([Attachment C](#)). This ROD/Final RAP is also provided on CD, whereby **blue text** serves as a hyperlink to reference information. The hyperlink will open a text box at the top of the screen. A blue box surrounds applicable information in the hyperlink. To the extent there may be inconsistencies between the referenced information attached to the ROD/RAP via hyperlinks and the information in the ROD/RAP itself, the language in this ROD/Final RAP controls.

Historically, the principal operation at Site 21 was the unloading of waste oil from ships and the transfer of the waste oil to an onshore oil-water separator at Site 21. Site 21 also contained several buildings, including Building 3. Volatile organic compound (VOC) contamination at Site 21 is believed to have resulted from operation of a solvent parts washing station located in the southwest corner of Building 3.

## 1.1 SELECTED REMEDY

The remedy selected in this ROD/Final RAP is necessary to protect public health, welfare, and the environment from actual or potential releases of contaminants from the site. The selected remedial action for Site 21 addresses chlorinated VOCs in groundwater. Chlorinated ethenes are the VOCs of concern at Site 21. The remedy consists of institutional controls (IC), which will be implemented to: (1) prohibit all uses of groundwater including groundwater extraction except for dewatering purposes; (2) require evaluation and potential installation of engineering controls~~vapor barriers~~ if new non-commercial buildings are constructed, or the current land use of existing buildings changes,~~or the land use of existing buildings exceeds 8 hours per day~~; and (3) prohibit residential use unless appropriate engineering controls are implemented that are protective of residential receptors. Future landowners may be permitted to develop Site 21 to residential uses by implementing engineering controls and performing operation and maintenance on those controls, to the extent necessary, to prevent exposure of future residents from inhalation of VOCs in groundwater through vapor intrusion to indoor air.

The selected remedial action is protective of human health and the environment, complies with federal and state statutes and regulations that are applicable or relevant and appropriate to the remedial action, and is cost-effective. The selected remedial action uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The remedy does not satisfy the statutory preference for treatment that reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element. Since this remedy will result in contaminants remaining on site above levels that allow for unrestricted use and unlimited exposure, a statutory review will be conducted within 5 years after the remedial action has been initiated to ensure that the remedy remains protective of human health and the environment.

## 1.2 DATA CERTIFICATION CHECKLIST

The following information is included in [Section 2](#) of this ROD/Final RAP. Additional information can be found in the Administrative Record file for this site.

Chemicals of concern (COC) and their concentrations	<a href="#">Sections 2.3 and 2.5</a>
Baseline risk represented by the COCs	<a href="#">Section 2.5</a>
Remediation goals established for COCs and the basis for these goals	<a href="#">Sections 2.7 and 2.9</a>
Principal threat wastes	<a href="#">Section 2.8</a>
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater	<a href="#">Section 2.4</a>

Potential land and groundwater use that will be available at the site as a result of the selected remedy	<a href="#">Section 2.11.3</a>
Estimated capital costs, annual operation and maintenance, and total present-worth costs; discount rate; and the number of years over which the remedy cost estimate is projected	<a href="#">Table 4</a>
Key factors that led to selecting the remedy (for example, a description of how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)	<a href="#">Section 2.11.1</a>



### 1.3 AUTHORIZING SIGNATURES

This signature sheet documents the Navy's selection of the remedy in this ROD/Final RAP. This signature sheet also documents the State of California's (DTSC and Water Board) concurrence with this ROD/Final RAP. The parties may sign this sheet in counterparts.

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Date

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Denise M. Tsuji  
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Bruce H. Wolfe  
Executive Officer  
San Francisco Bay Regional Water Quality Control Board

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Date

## 2. DECISION SUMMARY

### 2.1 SITE DESCRIPTION AND HISTORY

NAVSTA TI is located in San Francisco Bay within the City and County of San Francisco (Figure 1). The naval station consists of two contiguous islands connected by a causeway. The northern island, Treasure Island (TI), encompasses about 403 acres, and the southern island, Yerba Buena Island (YBI), encompasses about 147 acres (Figure 1). TI was constructed on the shoals of YBI with San Francisco Bay fill between 1936 and 1937 for use as an airport for the City of San Francisco. It was also the site of the 1939 Golden Gate International Exposition. Navy operations at TI began in 1941, primarily for training, administration, housing, and other support services to the U.S. Pacific Fleet. In 1993, the Defense Base Realignment and Closure Commission recommended closure of NAVSTA TI, and the facility was subsequently closed on September 30, 1997.

Site 21<sup>(1)</sup> is the former Vessel Waste Oil Recovery Area and is located along the southeastern shoreline of NAVSTA TI (Figure 1). Site 21 encompasses about 2.2 acres and is covered by asphalt, concrete, and buildings. Site 21 operated between 1946 and 1995 in various capacities. For most of the time, waste oil unloaded from ships was transferred to an onshore oil-water separator recovery system at Site 21 that consisted of five aboveground storage tanks, each with a capacity of 2,000 gallons. Waste oil from the ships was unloaded into cylindrical steel shells called “donuts.” The donuts floated partially above and partially below the water surface and did not have bottoms, which allowed contact between the waste oil and water. Once it was loaded with waste oil, the donut was maneuvered to shore and the waste oil was pumped through the oil-water separator. The recovered oil was recycled.

Several buildings were formerly or are currently located in or near Site 21 (Figure 2). A portion of Building 3<sup>(2)</sup> is within Site 21 and it housed the Shore Intermediate Maintenance Activity Facility, port and damage control services, and an applied instruction school for welding, cutting, and brazing. Chemicals stored in Building 3 included small quantities of battery fluid (sulfuric acid), several hundred gallons of paint, paint thinner, lubrication oil, and hydraulic fluid. Historically, Building 3 was used as an exhibition hall during the World’s Fair and as an aircraft (Clipper Ship) maintenance area. The Building 3 Annex, a small two-story structure attached to the southeastern portion of Building 3, was formerly used as office space. A dip tank located behind Building 3 was used to clean aircraft parts and motors.

Other buildings partially within or near Site 21 include Building 111, an old firehouse that was abandoned because of earthquake damage; and Building 112, a former small storage and office building. Building 112 was subdivided and portions were renumbered to include Buildings 12A, 12B, and 12C (demolished). Building 12A has most recently been used as the Harbor Master’s office, and Building 12B has been used for parts and tool storage.



Figure 1. Location of Treasure Island



**Figure 2. Site 21 Location and Site Features**

## **2.2 SITE CHARACTERISTICS**

TI is a relatively flat, manmade island consisting primarily of sand dredged from the San Francisco Bay and Delta region and is retained by a perimeter of rock and sand dikes. Asphalt, concrete, and buildings provide surface cover at Site 21 and are underlain by dredged fill and shoal deposits predominantly consisting of fine- to medium-grained sands, with varying proportions of shell fragments, silt, and clay. The dredged fill was emplaced on top of the shoal sands during construction of TI. Younger Bay Mud, consisting of inter-bedded sand, silt, and clay, underlies the shoal sands.



Generally, the **terrestrial habitat**<sup>(3)</sup> at NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Vegetated parts of NAVSTA TI are made up of lawns and landscaped areas planted with largely non-native species. Disturbance from vehicular traffic and widespread human presence also reduces the quality of the habitat for wildlife species.

**Groundwater at Site 21**<sup>(4)</sup> is encountered from 5.9 to 6.7 feet below ground surface (bgs). Based on interpretation of the groundwater elevation contour maps for Site 21, the direction of groundwater flow for both the shallow and intermediate zones is generally south to southeast, toward the shoreline. Gradients for the site vary and depend on proximity to the shoreline and the extent of tidal influence. Groundwater gradients usually are steeper near the shoreline.

Groundwater recharge at NAVSTA TI occurs primarily from infiltration of precipitation, with some contribution from landscape irrigation. Perched groundwater conditions may exist locally above the shallow water table because of the presence of relatively impermeable silt and clay lenses.

## 2.3 PREVIOUS INVESTIGATIONS

Potential contamination at Site 21 is associated with **VOCs in groundwater**<sup>(5)</sup>. Assessment of contamination and risk for Site 21 is based on the Final Remedial Investigation Report. **Table 1** summarizes the previous studies and investigations conducted at Site 21.

## 2.4 CURRENT AND POTENTIAL FUTURE SITE USES

The current use of Site 21 includes a regional sailing and boat storage facility and occasional movie production in Building 3. At the time that the Navy conducted the Remedial Investigation and Focused Feasibility Study, the future plans for Site 21 were described in the 1996 “Naval Station Treasure Island Reuse Plan – Public Review Draft.” According to this plan, the reuse of the portion of NAVSTA TI that includes Site 21 was designated as “Film Production/Conference Center.” This area includes land that could have been used for “publicly oriented recreation/cultural/entertainment” and specifically as a film and events district.

In 2011 the NAVSTA TI reuse plans have been changed. The 2011 Final **Environmental Impact Report (EIR)**<sup>(6)</sup> lists the proposed future uses of the portion of NAVSTA TI that includes Site 21 as open space and Island Center district. The Island Center district is described as a dense mix of residential, retail, restaurant, and office space. Specifically for the area encompassing Site 21, the EIR states that Building 3 will be rehabilitated and reused for commercial, retail, entertainment, community services, and food production uses. Building 111, an ancillary building attached to Building 3, would be demolished and portions of Site 21 will be used for mixed use which may include residential use. According to the 1996 “Naval Station Treasure Island Reuse Plan — Public Review Draft,” the ~~reuse~~<sup>(6)</sup> of the portion of NAVSTA TI that includes Site 21 is designated as a “Film Production/Conference Center.” This area includes land that could be used for “publicly oriented recreation/cultural/entertainment” and specifically as a film and events district. However, because the redevelopment plans have not been

~~finalized, in addition to the above uses, there is a potential that Site 21 could be used for residential use.~~

**TABLE 1. PREVIOUS INVESTIGATIONS AT SITE 21**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Previous Investigations*	Date	Investigation Summary
Preliminary Assessment and Site Inspection (PA/SI)	1988	The PA/SI Report included observations made during the SI, information from personnel interviews, and a review of historical records and aerial photographs. The PA/SI Report concluded that the areas of operation between Building 3 and San Francisco Bay (now Site 21) warranted further investigation because of the potential for soil and groundwater contamination from past site operations.
Phase I Remedial Investigation (RI)	1992	A Phase I basewide RI was conducted at the PA/SI sites to assess the nature and extent of soil and groundwater contamination at each site. During Phase I, 15 soil samples were collected from five locations at Site 21 to evaluate whether soils adjacent to the donut storage area and the oil-water separation system were contaminated with total petroleum hydrocarbons (TPH). Soil samples were analyzed for metals, VOCs, semivolatile organic compounds (SVOC), and TPH-extractables. VOCs were not reported in samples from any of the five soil borings installed as part of the Phase I RI. TPH-diesel was not reported in concentrations that exceed the NAVSTA TI screening criteria. SVOCs were not reported in soil samples collected during the phase I RI.
Inactive Fuel Line Investigation	1994-2003	In 1994, the Navy collected soil samples from borings around the abandoned fuel pipeline that crossed Site 21. In 1997 and 2000, additional samples were collected from excavations made during pipeline removal and boring activities. Soil and groundwater samples were analyzed for metals, VOCs, SVOCs, pesticides, TPH-gasoline range organics, and total recoverable petroleum hydrocarbons. Corrective action was not recommended for shallow soil at Site 21 based on the fuel line investigation results. Additionally, the investigation results indicated the source of TPH (the fuel line) had been removed and TPH contamination in groundwater was limited. Therefore, no further corrective action was recommended for TPH in groundwater. However, it was recommended that metals in soil and VOCs and SVOCs in groundwater be addressed in the Site 21 RI report.
Tidal Mixing Studies	1995-2002	<p>In 1995, an initial study assessed the inland extent of tidal influence on near-shore groundwater levels at NAVSTA TI. During the first study, fluctuations in the groundwater table between high and low tides ranged from 1.81 feet at 30 feet from San Francisco Bay to 0.12 foot at 250 feet from the San Francisco Bay. The tidal fluctuation in San Francisco Bay was measured at 5.37 feet during the corresponding period. A follow-up study was performed between December 2001 and March 2002 to assess the degree of subsurface mixing of groundwater and surface water immediately inland of the shore at TI. The findings from these studies estimated that physical mixing of surface water and groundwater takes place over distances ranging from 60 to 150 feet inland from the TI mean lowest low water shoreline. Significant temporal and spatial variations were observed in the degree of tidal mixing.</p> <p>Estimates of the degree of tidal mixing of surface water and groundwater for TI ranged from 10 to 17 percent, except for a transect in the southeastern portion of TI. The transect is located on Site 21. Tidal mixing was conservatively estimated at 43 percent within this southeastern portion of TI. However, conditions encountered in this transect are considered unusual and represent only the area immediately surrounding that transect.</p>

**TABLE 1. PREVIOUS INVESTIGATIONS AT SITE 21 (CONTINUED)**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Previous Investigations*	Date	Investigation Summary
Basewide Groundwater Monitoring Program	1995-2003	The NAVSTA TI facility-wide groundwater monitoring program provided data in support of site-specific environmental investigations throughout NAVSTA TI and the related documents such as corrective action plans for applicable petroleum program sites and RIs for applicable CERCLA sites. Analytical data for groundwater samples and water levels collected from numerous monitoring wells during quarterly groundwater monitoring are documented in groundwater status reports. The final Site 21 RI report summarizes data gathered from Site 21 monitoring wells during quarterly groundwater monitoring events conducted from November 1995 to September 1996, January to November 1998, March to October 2000, and May 2001 to August 2002.
Ambient Metals Studies	1996-2001	Ambient concentrations were established for metals in soil and groundwater to assess whether the presence of any metal was the result of a site-specific release or if it was from naturally occurring or regional anthropogenic sources. A study of the ambient concentrations of metals in soil was conducted in 1996; the ambient groundwater metals concentrations study was completed in 2001. These studies are included as Appendices F and G of the Final Site 21 RI Report.
Environmental Baseline Survey (EBS)	1997	The Navy conducted an EBS at NAVSTA TI in November 1997. During the EBS, one sediment sample was collected from one catch basin at Site 21. VOCs were not reported in the sediment sample, which was analyzed only for benzene, toluene, ethylbenzene, and m,p,o – xylenes. No soil or groundwater samples were collected at Site 21 during the EBS.
Phase II RI	1997	<p>Phase IIA of the basewide RI was conducted to determine the mean hydraulic gradient and direction of groundwater flow throughout NAVSTA TI. During the basewide Phase IIB RI, soil and groundwater samples were collected at Site 21 from (1) near the oil recovery system and fuel oil pipeline to assess the extent of petroleum contamination, and (2) near the sampling location where VOCs were detected in groundwater (soil boring SCI-TI-11) during the inactive fuel line investigation. Soil and groundwater samples were analyzed for metals, SVOCs, and TPH-extractables. Groundwater samples were also analyzed for VOCs.</p> <p>Based on the results of the Phase I and Phase IIB RIs, an FS was recommended to evaluate remedial alternatives for VOC-contaminated soils, and additional groundwater sampling was recommended to assess potential migration of the chlorinated VOC groundwater plume.</p>
Treatability Study	2005-2010	Phase 1 of the Site 21 <a href="#">treatability study</a> <sup>(7)</sup> was conducted from August 2005 to May 2006 to evaluate the effectiveness of enhanced anaerobic in situ bioremediation (ISB) of VOCs in groundwater. An ISB system was installed within the VOC plume and consisted of two well networks: (1) ISB injection point wells, and (2) permeable reactive barrier (PRB) wells. The ISB system consisted of bioaugmentation of dechlorinating bacteria cultures and injection of sodium lactate in ISB injection point wells, and EHC compound in PRB wells. The PRB wells were designed to prevent lateral migration of contaminated groundwater at the San Francisco Bay shoreline. EHC is a patented combination of controlled-release, complex carbon and zero valent iron used for in situ chemical reduction. Phase 2 of the treatability study was conducted from June 2008 to April 2010. Pre-treatability study groundwater concentrations, as reported in the RI, and post-treatability study groundwater concentrations, as reported in the treatability report, meet remedial goals. The treatability study is discussed in <a href="#">Section 2.6</a> .



**TABLE 1. PREVIOUS INVESTIGATIONS AT SITE 21 (CONTINUED)**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Previous Investigations*	Date	Investigation Summary
Final RI	2007	<p>The <a href="#">Final RI report</a><sup>(8)</sup> presented the analytical results of all investigations completed at Site 21, including the inactive fuel line investigation, the Phase I and Phase II RIs, the EBS investigation, the basewide quarterly groundwater monitoring, and the Site 21 RI. Data collected during these investigations was used to evaluate site conditions for the human health risk assessment (HHRA) and the ecological risk assessment (ERA) and screening-level ERA (SLERA).</p> <p>The HHRA concluded that VOCs in groundwater were the COCs at Site 21, no soil COCs were identified. The SLERA concluded that the industrial setting and managed habitat on TI were inadequate to support healthy terrestrial ecological populations. The SLERA concluded that chemical migration in groundwater from Site 21 does not pose an unacceptable risk to benthic invertebrates or other aquatic biota offshore of NAVSTA TI.</p>
Focused Feasibility Study (FFS)	2009	<p>The FFS report provided a comparative analysis of remedial alternatives to address chlorinated VOCs in groundwater at Site 21. Enhanced anaerobic ISB was the only treatment technology carried forward for evaluation in the FFS report based on results of the Site 21 treatability study that demonstrated that enhanced anaerobic ISB was capable of reducing chlorinated VOCs to ethene gas. In 2007 during development of the FFS, the Navy made a risk management decision to identify chemicals as COCs for nonresidential receptors if the chemical-specific ELCR exceeded <math>1 \times 10^{-5}</math> or the chemical-specific incremental hazard index (HI) exceeded 1. Based on this decision and pre-treatability study concentrations in groundwater, VOCs identified in groundwater did not pose risks to commercial/industrial workers and construction workers (the anticipated future receptors). However, the Navy chose to develop remedial action objectives (RAO) and remedial goals for future commercial/industrial workers and future construction workers that address the intermediate degradation products produced during the in situ treatment. Three remedial alternatives were evaluated: (1) no action; (2) ICs and (3) enhanced anaerobic ISB of groundwater and groundwater monitoring.</p>
Proposed Plan/Draft RAP	2011	<p>The Proposed Plan/Draft RAP identified the Navy's preferred alternative for Site 21 and invited the public to review and comment on the preferred alternative prior to selection of the final remedy. The preferred alternative is Alternative 2, which consists of ICs. A public meeting held in November 2011 provided an additional opportunity for the public to learn about the Proposed Plan/Draft RAP and provide comments.</p>
<a href="#">Soil Gas Investigation and Risk Assessment Addendum</a>	<a href="#">2012</a>	<p><a href="#">The soil gas investigation included collecting vadose zone soil gas samples to (1) define the extent of chlorinated VOCs in soil gas above and surrounding the chlorinated VOC groundwater plume and (2) calculate the potential human health risk associated with vapor intrusion using the VOC concentration in soil gas. The results of the soil gas investigation show that the extent of chlorinated VOC concentrations in soil gas is within the boundary of the chlorinated VOC groundwater plume. The risk assessment addendum included a calculation of human health risk using soil gas data rather than groundwater data, as was used in the RI HHRA. Vapor intrusion analysis confirmed that the potential human health risk from chlorinated VOCs in soil gas at Site 21 is acceptable for commercial and industrial use.</a></p>
<a href="#">Post-Treatability Study Groundwater</a>	<a href="#">2012</a>	<p><a href="#">The groundwater monitoring report summarizes data collected during four different sampling events in 2011 and 2012. The data were collected to assess the continued reduction of chlorinated VOC concentrations in groundwater</a></p>

**TABLE 1. PREVIOUS INVESTIGATIONS AT SITE 21 (CONTINUED)**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Previous Investigations*	Date	Investigation Summary
Monitoring		<u>after additional treatability study treatment was conducted in 2010. The report documents that the chlorinated VOC concentrations in groundwater remain below the remedial goals; however, a few detections of chlorinated VOCs in groundwater are above residential risk-based concentrations.</u>

Notes:

\* The documents listed are available in the Administrative Record and provide detailed information used to support remedy selection at Site 21.

## 2.5 SUMMARY OF SITE RISKS

In the Final RI Report, the Navy evaluated potential risks to human health and ecological receptors from chemicals released at Site 21 using pre-treatability study groundwater concentrations. These human health and ecological risks are discussed in [Sections 2.5.1 and 2.5.2](#) and represent risk associated with pre-treatability study groundwater concentrations. Groundwater concentrations have been reduced as a result of implementing the treatability study.

### 2.5.1 Human Health Risk Assessment

An HHRA estimates the risks posed if no action is taken. The HHRA provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed to prevent potential risk to human health. This section of the ROD/Final RAP describes the risk assessment process and summarizes the results of the Site 21 HHRA, conducted as part of the RI using pre-treatability study groundwater concentrations.

#### 2.5.1.1 Identifying Chemicals of Potential Concern

Chemicals of potential concern (COPC) represent those chemicals assumed to account for the majority of any estimated health impacts at a site. [Two approaches to COPC selection](#)<sup>9)</sup> were adopted:

- **Incremental Risk COPC List.** The calculation of incremental risk follows Navy and EPA guidance for use of a concentration-toxicity screen in selecting COPCs. Incremental risk includes (1) risk from inorganic chemicals present at concentrations that exceed ambient levels and risk-based screening levels, and (2) risk from organic chemicals present at concentrations that exceed risk-based screening levels. Inorganic chemicals that are essential nutrients and chemicals infrequently reported (a detection frequency of less than 5 percent) are not included in the evaluation of incremental risk. The incremental risk characterization at Site 21 incorporated federal toxicity criteria and follows the EPA hierarchy for selection of toxicity criteria. Toxicity criteria are discussed in [Section 2.5.1.3](#).
- **Site Risk COPC List.** Site risk represents the risk from exposure to all analytes reported at concentrations above ambient levels at a site and follows DTSC guidance for selecting COPCs. Site risk includes (1) risk from all reported inorganic chemicals (except essential nutrients) if they are reported at concentrations greater than ambient levels, and (2) risk from all reported organic analytes. Chemicals infrequently reported (a detection frequency of less than 5 percent) are not included in the evaluation of site risk. The quantification of site risk follows DTSC guidance for the evaluation of chemicals present at concentrations greater than background.

Consistent with EPA and Navy guidance, soil COPCs for the incremental and site risk scenarios were selected as follows:

- If an inorganic chemical is considered an essential nutrient (such as calcium, iron, magnesium, potassium, or sodium), it was excluded as a COPC if the maximum reported concentration fell below levels associated with adverse health effects.
- If concentrations of an inorganic chemical were within ambient levels based on statistical comparison, it was excluded as a COPC. Statistical comparisons were based on two population tests including the Wilcoxon Rank Sum and Gehan-Wilcoxon Tests, Tests of Proportions, and Quantile Test.

~~As noted above in Section 2.4, In 2001,~~ the Water Board recommended that the basin plan be revised to exclude groundwater at TI as a potential source of municipal or domestic water. Because **groundwater**<sub>(10)</sub> is not currently used as a source of drinking water and it is not likely that groundwater at Site 21 will be used as a source of drinking water in the future, potential exposure to chemicals in groundwater would occur only through inhalation of volatile compounds migrating upward into the air (breathing zone) or if groundwater infiltrated a construction trench. Inhalation of volatile compounds in indoor air within a building and outdoor air within a construction trench and dermal contact with groundwater are the only complete exposure pathways for chemicals reported in groundwater at Site 21. All data were screened, however, to evaluate whether formal ICs would be necessary to ensure no future wells would be installed.

COPCs were selected for the potentially complete future vapor intrusion pathway (migration of volatile compounds upward from groundwater into indoor air) as follows for the incremental and site risk scenarios.

- For the incremental risk scenario, if the maximum reported concentration of a VOC in groundwater exceeded the EPA risk-based concentrations for the vapor intrusion pathway, it was retained as a COPC. The groundwater values selected for screening were adopted from EPA's Table 2c "Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils," which are based on a cancer risk of  $10^{-6}$  and a hazard quotient of 1 for each chemical.
- For the site risk scenario, all VOCs detected at a frequency of greater than 5 percent in all samples were retained as indoor air COPCs; that is, no concentration-toxicity screen was used.

**Tables 6-1 and 6-2 of the RI**<sub>(11)</sub> present the lists of COPCs for soil and groundwater considered for the incremental and site risk scenarios.

### **2.5.1.2 Exposure Assessment**

Under the **exposure assessment**<sub>(12)</sub>, potential human populations and related exposure pathways are identified based on current and expected future land uses. Considerations relevant to predicted current and future exposures at Site 21 considered spatial location of the site as well as probable reuse patterns. A future residential scenario was evaluated to account for the possibility that homes would be built on the site in the future.

This step also involves compiling or developing receptor-specific intake assumptions, estimating **exposure point concentrations**<sup>(13)</sup> (EPCs), and estimating daily chemical intakes for each receptor. EPCs and chemical intakes are used to estimate pathway-specific intakes (doses) for use in subsequent risk calculations. For Site 21, a hypothetical future resident, a commercial/industrial worker, and a construction worker receptor were evaluated. A recreational user was not evaluated at Site 21 because commercial/industrial worker reuse is considered more conservative than recreational reuse. The **HHRA conceptual site model**<sup>(14)</sup> used to guide the exposure assessment is presented as Figure 6-1 of the RI.

For all receptors evaluated at Site 21, both a reasonable maximum exposure (RME) and a central tendency exposure (CTE) were evaluated. An RME scenario represents a plausible upper-end exposure, while a CTE scenario represents an average or more typical exposure. The EPC for the RME and CTE scenarios was the lesser of the maximum reported concentration and the 95th percentile upper confidence limit on the arithmetic mean.

### **2.5.1.3 Toxicity Assessment**

The **toxicity assessment**<sup>(15)</sup> of the HHRA included identification of toxicity values used to characterize noncancer health effects and cancer risk. Toxicity factors recommended by EPA Region IX were compiled from EPA-approved sources following the recommended hierarchy: (1) Integrated Risk Information System; (2) Provisional Peer-Reviewed Toxicity Values developed by the National Center for Environmental Assessment; and (3) other Tier 3 sources, including the Health Effects Assessment Summary Tables and State of California reference exposure levels and cancer potency values.

**Tables I-5.1.EPA, I-5.2.EPA, I-6.1.EPA, and I-6.2.EPA**<sup>(16)</sup> of Appendix I of the RI present the toxicity values used for the estimation of incremental risk. State of California OEHHA toxicity values assumed the first tier of the toxicity criteria hierarchy, followed by EPA toxicity values. Toxicity values used for the estimation of site risk are also presented in Appendix I.

Using these criteria, toxicity values were compiled for each COPC identified, and cancer risks and noncancer adverse health effects were estimated for incremental and site risk characterization. A separate “total risk” sensitivity analysis was incorporated as detailed in Section 1.11.2 of Appendix I of the RI.

### **2.5.1.4 Risk Characterization**

The **risk characterization**<sup>(17)</sup> step combines the results of the previously described steps to estimate cancer risks and noncancer effects (as HIs). For each receptor, cancer risks and chemical-specific hazard quotients (HQ) were estimated separately for each COPC and each complete exposure pathway. Cancer risk estimates and HQs were then summed across all chemicals, media, and exposure pathways for a combined effect estimate. Site 21 risks were compared to the noncancer HI threshold of 1 (HI less than or equal to 1 for noncancer effects), and  $10^{-6}$  for the cancer risk management range. Where noncancer HIs exceeded 1, effects were segregated by target organ to determine whether systemic effects would be unacceptable for a

specific target organ or system. In addition, cancer risk between  $10^{-6}$  (1 in 1,000,000) and  $10^{-4}$  (1 in 10,000) are described as being within the risk management range.

### **2.5.1.5      Uncertainty Analysis**

The HHRA includes a number of **uncertainties**<sup>(18)</sup> that are inherent in the risk assessment process. Depending on the type of uncertainty, impacts to the results of the HHRA can include an over- or underestimation of cancer risks or HIs. Uncertainties were identified in association with four areas of the exposure assessment process: (1) the selection of exposure scenarios, (2) the selection of exposure pathways, (3) the estimation of EPCs, and (4) the selection of exposure variables used to estimate chemical intake.

### **2.5.1.6      Results of HHRA**

The HHRA evaluated exposure to soil from incidental soil ingestion, dermal contact with soil, and inhalation of chemicals released from soil to outdoor air from volatilization or wind erosion for the current and future commercial/industrial worker, the future construction worker and the future resident. The HHRA also evaluated exposure to groundwater from inhalation of chemicals released from groundwater to indoor air for the current and future commercial/industrial worker and the future resident. For the future construction worker, the HHRA evaluated exposure to groundwater from dermal contact with groundwater in an excavation trench and inhalation of outdoor air in an excavation trench. The HHRA used pre-treatability study groundwater concentrations to evaluate risk; groundwater concentrations have been reduced as a result of implementing the treatability study. **The HHRA concluded**<sup>(19)</sup> that (1) cancer risks were within the risk management range for all receptors and all pathways except for the future resident, and (2) noncancer hazard indices were below 1 for all receptors and all pathways, except for the future construction worker and future resident. For the future construction worker, because the noncancer hazard was 2 and therefore exceeded the threshold of 1, a target organ analysis was conducted. The target organ hazard indices were equivalent to 1, or below 1. Therefore noncancer hazards for the future construction worker are acceptable and no RAO was developed. For the future resident, the noncancer hazard was 25 and a target organ analysis was conducted which found hazard indices for blood at 23 and for the liver at 2.

The HHRA presented in the 2007 final Site 21 RI report identified a COPC as a COC if the chemical-specific incremental risk exceeded  $1 \times 10^{-6}$  or the chemical-specific incremental HI exceeded 1. However, in 2007, the Navy made a risk management decision for non-residential receptors at Site 21. The Navy chose to identify COCs as those chemicals which presented a chemical-specific incremental risk that exceeded  $1 \times 10^{-5}$  or the chemical-specific incremental HI that exceeded 1. As a result of this decision, COCs were identified only for the hypothetical future resident. **Table 2** lists the COCs identified for Site 21 in the HHRA (based on chemical-specific incremental risk exceeding  $1 \times 10^{-6}$ ) and the revised COC list based on the risk management decision (chemical-specific incremental risk exceeding  $1 \times 10^{-5}$ ). Both COC lists are based on the incremental risk estimate. The Navy's risk management decision is appropriate for Site 21 based on current and future site conditions, including risk drivers that are present only

in groundwater and an exposure duration that is limited by likely future commercial/industrial and open space use~~proposed future use activities~~.

**TABLE 2. CHEMICALS OF CONCERN FOR GROUNDWATER**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Chemicals of Concern Based on HHRA Results Presented in Site 21 RI						
Receptor	Exposure Point	Carcinogenic COCs <sup>a</sup>		Noncarcinogenic COCs <sup>a</sup>		Exposure Pathway Associated with COC
		COC	Chemical-Specific Cancer Risk	COC	Chemical-Specific Noncancer Hazard	
Current Commercial/Industrial Worker	Building 3 Annex	PCE	$1.8 \times 10^{-6}$	--	--	Inhalation (groundwater vapor intrusion)
Current Commercial/Industrial Worker	Building 111	PCE TCE Vinyl chloride	$3.2 \times 10^{-6}$ $1.6 \times 10^{-6}$ $1.6 \times 10^{-6}$	--	--	Inhalation (groundwater vapor intrusion)
Future Commercial/Industrial Worker	Hypothetical building over plume	PCE TCE Vinyl chloride	$4.6 \times 10^{-6}$ $2.3 \times 10^{-6}$ $2.4 \times 10^{-6}$	--	--	Inhalation (groundwater vapor intrusion)
Future Construction Worker <sup>b</sup>	Construction trench	PCE	$7.4 \times 10^{-6}$	--	--	Dermal contact (groundwater accumulation in construction trench)
Future Resident	Hypothetical building over plume	PCE TCE Vinyl chloride	$1.4 \times 10^{-4}$ $6.8 \times 10^{-5}$ $1.0 \times 10^{-4}$	cis-1,2-DCE	23	Inhalation (groundwater vapor intrusion)
COCs Based on 2007 Risk Management Decision						
Future Resident	Hypothetical building over plume	PCE TCE Vinyl chloride	$1.4 \times 10^{-4}$ $6.8 \times 10^{-5}$ $1.0 \times 10^{-4}$	cis-1,2-DCE	23	Inhalation (groundwater vapor intrusion)

Notes:

a COCs are based on results of the incremental human health risk assessment for Site 21.

b The noncancer hazard for the future construction worker was 2 and therefore a target organ analysis was conducted. The target organ hazard indices were equivalent to 1, or below 1.

-- No COCs or Chemical-Specific Noncancer hazards were identified.

COC Chemicals of concern

DCE Dichloroethene

PCE Tetrachloroethene

TCE Trichloroethene



## 2.5.2 Ecological Risk Assessment

Two **SLERAs**<sup>(20)</sup> were conducted to evaluate potential risk to terrestrial and aquatic wildlife at Site 21. In 2006, a SLERA was conducted to evaluate the potential for terrestrial receptors to be exposed to soil at Site 21. The SLERA did not identify any ecological resources or processes at TI that needed to be protected or sustained.

As part of the Final RI in 2007, a SLERA was conducted to evaluate the potential risk to aquatic wildlife. No freshwater or wetland habitats are present at NAVSTA TI. Generally, the terrestrial habitat at NAVSTA TI was found to be of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Vegetated parts of NAVSTA TI are made up of lawns and landscaped areas planted with largely non-native species. Disturbance from vehicular traffic and widespread human presence also reduce the quality of the habitat for wildlife species. Based on fate and transport models, chemicals of potential ecological concern (COPEC) to marine habitat were found to decrease sufficiently and pose little potential risk to benthic invertebrates or other aquatic biota offshore. The SLERA concluded that further evaluation of risk to terrestrial receptors or aquatic receptors in a baseline ecological risk assessment is not warranted.

The Site 21 SLERA specifically addresses reported chemicals in Site 21 groundwater, using pre-treatability study groundwater concentrations, and the potential risk to aquatic receptors associated with migration of these chemicals to the offshore surface waters of San Francisco Bay (see Appendix J of the final RI report). Six chemicals were originally suspected as COPEC (chromium, copper, mercury, nickel, silver, and trichloroethene [TCE]) during the initial screening process using **BIOCHLOR** and **BIOSCREEN**<sup>(21)</sup> models. However, fate and transport evaluations of these chemicals to the ecological point of exposure at Site 21 demonstrated that specific chemical concentrations in groundwater decrease to levels within acceptable risk ranges (see Section 5.1 in Appendix J of the Final RI Report). Therefore, no chemicals of ecological concern were identified at Site 21. The conclusions of the SLERA are not affected by the change in groundwater VOC concentrations as a result of chlorinated ethene degradation during the treatability study. A review of the post-treatability study groundwater data, found that the PRB constructed by the direct injection of EHC has been effective in preventing chlorinated ethenes from entering the bay.

## 2.6 TREATABILITY STUDY

The Navy conducted a treatability study at Site 21 to evaluate the applicability of ISB to treat chlorinated ethenes in groundwater. Phase 1 of the study was conducted from August 2005 to May 2007, and Phase 2 was conducted from June 2008 to April 2010. The purpose of the treatability study was to assess the effectiveness of the enhanced degradation of chlorinated ethenes using an anaerobic ISB process at the site.

Phase 1 included installation of a PRB by injection of EHC slurry into six injection locations at the downgradient edge of the plume. It also included the installation of 45 injection points and installation of one monitoring well. During Phase 1, geochemical parameters that would indicate biodegradation were measured. The geochemical analysis confirmed that the bioaugmentation



and biostimulation created reducing conditions conducive to anaerobic biodegradation of chlorinated ethenes. The PRB successfully prevented migration of chlorinated ethenes into the bay. Hydrogen injections at the most contaminated part of the site helped to reduce chlorinated ethenes significantly. However, concentrations of chlorinated ethenes rebounded at the upgradient end of the central part of the plume.

Phase 2 of the treatability study included (1) direct injection of the substrate and the dechlorinating microbial consortium; (2) extraction of 39,000 gallons of groundwater; and (3) the direct injection of buffered lactic acid at 32 locations to evaluate the effectiveness of anaerobic treatment for degrading chlorinated solvents in groundwater beneath the site. The geochemical analysis confirmed that the substrate injections created the highly reducing conditions conducive to anaerobic biodegradation of chlorinated ethenes. ISB was shown to be an effective mechanism for treatment of the low concentrations of chlorinated ethenes at Site 21.

## **2.7 BASIS FOR RESPONSE ACTION**

The remedial action selected in this ROD/Final RAP is necessary to protect public health, welfare, and the environment from actual or potential releases of hazardous substances into the environment. The Navy, in partnership with DTSC, the Water Board, and EPA, considered all pertinent factors in accordance with CERCLA and NCP remedy selection criteria and concluded that remedial action is necessary to address contaminated groundwater at Site 21. This determination was made because of the potential for receptors to be exposed to VOC contaminated groundwater and VOC inhalation via vapor intrusion.

## **2.8 PRINCIPAL THREAT WASTE**

Although a remedial response action is necessary, there are no wastes at Site 21 that constitute a “principal threat.” Principal threat wastes are hazardous or highly toxic source materials that result in ongoing contamination to surrounding media, generally cannot be reliably contained, or present a significant risk to human health or the environment should exposure occur. Contaminated groundwater is not generally considered to be source material unless it has the potential to be extremely mobile. Based on a review of the data, the plume of VOCs in groundwater at Site 21 is stable. Therefore, VOC-contaminated groundwater at Site 21 is not considered a principal threat waste.

## **2.9 REMEDIAL ACTION OBJECTIVES**

RAOs are established based on attainment of regulatory requirements, standards, and guidance; contaminated media; COCs; potential receptors and exposure scenarios; and human health and ecological risks. Ultimately, the success of a remedial action is measured by its ability to meet the RAOs. Although groundwater conditions at Site 21 do not pose an unacceptable risk for current receptors, the treatability study caused fluctuations in VOC concentrations as degradation of VOCs was occurring. Therefore the Navy chose to develop RAOs and remedial goals for future commercial/industrial workers and future construction workers to address the degradation products produced during the treatability study. The Navy developed the following RAOs to

address exposure of future commercial/industrial and future construction workers to post-treatability study VOC concentrations:

- Prevent exposure of future commercial/industrial workers through inhalation of VOCs in groundwater that migrate through the subsurface to indoor air (vapor intrusion) from groundwater that contains VOCs at concentrations above remedial goals.
- Prevent exposure of future construction workers through dermal contact with and inhalation of VOCs in groundwater that contains VOCs at concentrations above remedial goals in a construction trench.

The RAOs were based on the most likely future use of the property as commercial and industrial. These RAOs are also protective of recreational users. No RAOs were developed for future residents. However, the 2011 EIR proposes mixed use that may include residential use for Site 21. ICs will be implemented that will prohibit residential use unless appropriate engineering controls are implemented that are protective of future residents on site. . There is no RAO for the future resident. Instead, institutional controls will be implemented that will prohibit residential use unless appropriate engineering controls are implemented that are protective of residential receptors.

Table 3 summarizes the risk-based concentrations and remedial goals developed for Site 21 in the FFS.

## 2.10 DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

In the FFS Report, a one-step process was used to identify remedial alternatives for Site 21. EPA guidance states that when circumstances limit the number of available options, and therefore the number of alternatives to be developed, it may not be necessary to screen alternatives before the detailed analysis. A treatability study for ISB, begun in August 2005, had successfully reduced chlorinated ethene concentrations in groundwater at Site 21. Therefore, the FFS did not include a detailed screening of technologies and process options. The following three remedial alternatives were developed for Site 21 to comply with CERCLA, the NCP, and Department of Defense policy: (1) no action; (2) ICs; and (3) enhanced anaerobic ISB (including PRB wells and ISB treatment system wells) and groundwater monitoring.

### 2.10.1 Description of Remedial Alternatives

Table 4 provides the major components, details, and cost of each remedial alternative identified for groundwater.

### 2.10.2 Comparative Analysis of Alternatives

A comparative analysis of alternatives with respect to the **nine evaluation criteria**<sup>(22)</sup> was completed. The analysis is presented in Table 5 and described in the text that follows. The no action alternative was included in the FFS for comparison as required by the NCP.

**TABLE 3. SITE 21 RISK-BASED CONCENTRATIONS AND REMEDIAL GOALS FOR GROUNDWATER**  
Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Receptor	Chemical	Risk-Based Concentration <sup>a</sup> (µg/L)	Remedial Goal <sup>b</sup> (µg/L)
Current Commercial/Industrial Worker (Building 111) <sup>c</sup>	Cis-1,2-DCE	9,450	--
	PCE	326	--
	TCE	1,520	--
	trans-1,2-DCE	8,520	--
	Vinyl chloride	165	--
Future Commercial/Industrial Worker (Hypothetical Building Over Plume)	Cis-1,2-DCE	9,450	--
	PCE	326	--
	TCE	1,520	--
	trans-1,2-DCE	8,520	--
	Vinyl chloride	165	165
Future Construction Worker	Cis-1,2-DCE	712	712
	PCE	86	86
	TCE	56	56
	trans-1,2-DCE	1,420	1,420
	Vinyl chloride	336	-
Hypothetical Future Resident (Adult and Child)	Cis-1,2-DCE	630	-- <sup>d</sup>
	PCE	5	-- <sup>d</sup>
	TCE	11.5	-- <sup>d</sup>
	trans-1,2-DCE	170	-- <sup>d</sup>
	Vinyl chloride	2	-- <sup>d</sup>

Notes:

- a Risk-based concentrations for carcinogenic chemicals (PCE, TCE, and vinyl chloride) are based on a target cancer risk of  $10^{-6}$  for nonresidential receptors and a target cancer risk of  $10^{-6}$  for hypothetical future residential receptors. Risk-based concentrations for noncarcinogenic chemicals (cis-1,2-DCE and trans-1,2-DCE) are based on a target noncancer hazard quotient of 1.
- b Remedial goals were selected based on the lowest risk-based concentrations for a future commercial/industrial worker and future construction worker.
- c The risk-based concentrations for the current commercial/industrial worker at Building 111 are based on risk-based concentrations for a future commercial/industrial worker in a hypothetical building; risk-based concentrations for the future worker and hypothetical building are lower (that is, more health-protective) than Building 111-specific risk-based concentrations.
- d No RAO and no remedial goals were developed for the hypothetical future resident; however, residential use was evaluated as a hypothetical future land use scenario to develop the unrestricted use alternative.
- Not applicable
- µg/L Microgram per liter
- COC Chemical of concern
- DCE Dichloroethene
- PCE Tetrachloroethene
- TCE Trichloroethene

**TABLE 4. SUMMARY OF REMEDIAL ALTERNATIVES**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

Remedial Alternative	Components	Details	Cost <sup>1</sup>
1: No Action	None	Under this alternative, no further remediation would be performed. This alternative is required by CERCLA as a baseline for comparison with other alternatives.	None
2. Institutional Controls	Establishes restrictions on use of the property to prohibit activities that could result in human exposure to contaminated groundwater underlying Site 21	Establishes restrictions on the land use at Site 21 in the form of deed restrictions and land use covenants. Restrictions would limit exposure to VOCs by prohibiting future residential reuse, unless appropriate engineering controls are implemented, and prohibiting groundwater extraction (dewatering exempted).  Total Project Duration: 30 years	Total Present Value Capital Cost: \$205,000 Total Present Value O&M: \$172,000 Total Present Value Periodic Cost: \$190,000 Total Present Value Cost: \$567,000
3: Enhanced Anaerobic In Situ Bioremediation (ISB) of Groundwater and Groundwater Monitoring	Enhanced anaerobic ISB would be used to treat VOCs in groundwater to meet the risk-based concentrations for hypothetical future residential land use	Alternative consists of two well networks: (1) permeable reactive barrier (PRB) wells, and (2) ISB treatment system wells. The PRB wells would be designed to prevent migration of contaminated groundwater to San Francisco Bay. The ISB treatment system wells would be designed to create a biologically active treatment zone.  The enhanced ISB treatment system would consist of 71 injection point wells and would be installed within the VOC plume to biodegrade PCE and TCE in groundwater at Site 21 anaerobically. Two rounds of groundwater treatment would be anticipated for remediation of the VOC plume. Approximately 7,700 pounds of substrate would be applied to the aquifer during two rounds of ISB.  Total Project Duration: 6 years.	Total Present Value Capital Cost: \$1,294,000 Total Present Value O&M: \$961,000 Total Present Value Periodic Cost: \$ 68,000 Total Present Value Cost: \$2,323,000

## Notes:

1 Costs were developed in the FFS.

ISB	In-situ bioremediation	PRB	Permeable reactive barrier
O&M	Operations and Maintenance	TCE	Trichloroethene
PCE	Tetrachloroethene	VOC	Volatile organic compound

**TABLE 5. RELATIVE RANKING OF REMEDIAL ALTERNATIVES**

Record of Decision/Final Remedial Action Plan, Installation Restoration Site 21,  
NAVSTA Treasure Island, San Francisco, California

CERCLA Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Enhanced Anaerobic In Situ Bioremediation
<b>Threshold Criteria</b>			
Overall protection of human health and the environment	○	●	●
Compliance with ARARs	NA	●	●
<b>Balancing Criteria</b>			
Long-term effectiveness and permanence	○	●	●
Reduction of toxicity, mobility, or volume through treatment	○	○	●
Short-term effectiveness	●	●	◐
Implementability	●	●	◐
Present Worth Cost*	\$0	\$567,000	\$2,323,000
<b>Modifying Criteria</b>			
State Acceptance	PP	PP	PP
Community Acceptance	NC	NC	NC

Notes

○ = Low      ◐ = Medium      ● = High

\* Cost evaluation is based on net present value (NPV)

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

NA There are no ARARs applicable to Alternative 1

NC No changes were made because public comments received did not require a revision to the preferred alternative.

PP State acceptance of the selected remedy is documented in the Proposed Plan/Draft RAP and ROD/Final RAP

### 2.10.2.1 Threshold Criteria

**Overall Protection of Human Health and the Environment.** All alternatives protect human health and the environment under the current use of Site 21. However, only Alternatives 2 and 3 are protective of human health under future and hypothetical future land-use scenarios. Alternatives 2 and 3 would meet the threshold criterion for overall protection of human health, but Alternative 1 would not.

Alternative 1 would not protect future commercial/industrial and construction workers or hypothetical future residents from exposure to VOCs in groundwater underlying Site 21. This

alternative would provide no mechanisms to ensure its effectiveness in protecting human health and therefore is not eligible for selection because no enforcement or monitoring components are associated with Alternative 1.

Under Alternative 2, ICs would be implemented to ensure that human exposure pathways remain incomplete by (1) prohibiting groundwater use and groundwater extraction, except for dewatering purposes, and (2) prohibiting future residential reuse unless appropriate engineering controls are implemented that are protective of residential receptors.

Alternative 3 would treat and reduce VOC concentrations in groundwater underlying Site 21 to allow future hypothetical residential use of the site without any further land-use restrictions.

### ***Compliance with ARARs***

CERCLA § 121(d)(1) states that remedial actions at CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. Chemical-specific applicable or relevant and appropriate requirements (ARAR) are health- or risk-based numerical values or methods that, when applied to site-specific conditions, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment. Location-specific ARARs are restrictions on the concentrations of hazardous substances or on conducting activities solely because they are in specific locations. Specific locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs are technology- or activity-based requirements or limitations for remedial activities. These requirements are triggered by the particular remedial activities conducted at the site. Under Alternative 1, no action would be conducted, so ARARs are not evaluated for this alternative. Alternatives 2 and 3 would comply with the ARARs identified in [Attachment A](#) of this report. Thus, these alternatives were ranked equally based on this criterion.

### **2.10.2.2      *Primary Balancing Criteria***

#### ***Long-Term Effectiveness and Permanence***

The magnitude of residual risk would remain unchanged after implementation of Alternative 1. These residual risks do not pose an unacceptable risk to human health or the environment based on the current use of Site 21 as an infrequently used commercial/industrial site. However, these residual risks pose an unacceptable risk to human health under the hypothetical future residential use scenario. Alternative 1 would provide no protection from future risks and would not be effective in providing long-term effectiveness or permanence.

Alternative 2 would provide a high level of long-term effectiveness and permanence through the ICs. However, it would not reduce the chemical concentrations because VOCs would remain in groundwater at Site 21. In addition, residential use of the site would be prohibited unless appropriate engineering controls are implemented that are protective of residential receptors.

Alternative 3 would provide the highest level of long-term effectiveness and permanence by remediating Site 21 for unrestricted use. ICs are not part of Alternative 3, which increases its relative rating for long-term effectiveness. Alternative 3 has the highest level of long-term

effectiveness and permanence because biological degradation of VOCs is an irreversible reaction and the risk-based concentrations for residential use will be met.

### ***Reduction in Toxicity, Mobility, or Volume through Treatment***

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of contamination at Site 21 because no treatment would be implemented. Neither alternative would reduce VOC concentrations in groundwater beyond potential naturally occurring reductions because no treatment would be implemented.

Alternative 3 would provide the highest level of reduction in toxicity, mobility, and volume of VOCs through treatment. Alternative 3 would degrade the mass of VOCs in groundwater to allow unrestricted use of Site 21.

### ***Short-Term Effectiveness***

Alternative 1 would pose the lowest short-term risk because no action would be taken under Alternative 1. Under Alternative 1, there would be no exposure risks to the community, workers, or the environment because no remedial action would be conducted.

Alternative 2 has higher short-term effectiveness than Alternative 3. Alternative 2 would not involve remedial construction at Site 21. Therefore, in the short term, no construction would be required and no short-term risks to construction workers or the community would result. The timeframe to achieve remedial goals is less than under Alternative 3 because Alternative 2 would incorporate the use of ICs and not active treatment.

Alternative 3 would have the least short-term effectiveness, because it involves 1 month construction period, 1 year of operation, and 5 years of monitoring.

### ***Implementability***

Alternative 1 would require no action. Therefore, it has the highest implementability of the alternatives.

Alternative 2 would have a relatively higher level of implementability than Alternative 3. Alternative 2 would require agency concurrence. The applicable legal mechanisms would be selected during development of the Land Use Control remedial design (LUC RD) plan. Implementation of administrative steps could be undertaken with relative ease and would be highly feasible because the Navy and DTSC are both experienced with this process. The implementation period for ICs would be in perpetuity or until additional investigation or remediation demonstrates that the ICs are no longer required.

Alternative 3 would be the most difficult of the alternatives to implement because it would require the most infrastructure and time to complete remediation. However, wells installed in the plume area would be of standard construction, and materials and labor are readily available. Other materials, such as lactic acid, sodium lactate, and SDC-9 solution for bioaugmentation, are also widely used and available.



### *Cost*

No costs are associated with Alternative 1, so this alternative is most effective with respect to cost. The present value cost of Alternative 2 is \$567,000. It costs significantly less than Alternative 3 because no treatment of contamination would be required for this alternative. The present value of Alternative 3 is \$2,323,000, which is significantly higher than the cost of Alternative 2.

### **2.10.2.3      *Modifying Criteria***

#### *State Acceptance*

State involvement has been solicited throughout the CERCLA process. The Navy, DTSC, and the Water Board coordinated on all major documents and investigation activities associated with Site 21, including the RI and FFS. Based on these reviews and discussions of key documents, the state supports the remedy. The State of California's acceptance of the Navy's selected remedial alternative is documented in the Proposed Plan/Draft RAP and in this ROD/Final RAP.

#### *Community Acceptance*

Community acceptance is evaluated based on comments received from the public during the public comment period for the Proposed Plan/Draft RAP. The Proposed Plan/[Draft RAP](#) was presented to the community and discussed during a public meeting on November 2, 2011. Comments were also gathered during the public comment period from October 14, 2011, through November 14, 2011. [Attachment B](#), the responsiveness summary, of this ROD/Final RAP addresses the public's comments and concerns about the preferred remedial alternative at Site 21.

## **2.11            SELECTED REMEDY**

The selected remedy for Site 21 is Alternative 2, ICs.

### **2.11.1          Rationale for Selected Remedy**

Alternative 2 was selected because it prevents exposure to chlorinated ethenes in groundwater at Site 21 in both the short term and long term and will allow Site 21 to be redeveloped and used in a manner consistent with the approved local reuse plan, subject to enforcement of appropriate controls for protection of future commercial/industrial workers and residential receptors. Alternative 2 would provide the most cost-effective remedial alternative that is protective of human health. Alternative 2 would require approximately 1 year for implementation, followed by long-term site monitoring.

### **2.11.2          Description of Selected Remedy**

[ICs\(23\)](#) will be implemented throughout Site 21 to prohibit activities that could result in human exposure to areas where potential unacceptable risk is posed by chlorinated ethenes in groundwater. ICs are legal and administrative mechanisms used to limit the exposure of future landowners or users of the property to hazardous substances present on the property and to ensure the integrity of the remedial action. ICs are required on a property where the selected remedial cleanup levels result in contamination remaining at the property above



levels that allow for unlimited use and unrestricted exposure. ICs will be maintained until the concentrations of hazardous substances in groundwater are at such levels to allow for unrestricted use and exposure. Implementation of ICs includes requirements for monitoring and inspections and reporting to ensure compliance with land use or activity restrictions.

Alternative 2 consists of the following components:

- A deed notice will be recorded to notify the public about the existence of potential contamination at Site 21.
- A deed restriction will be recorded to: (1) prohibit all uses of groundwater beneath Site 21 including groundwater extraction, except for dewatering purposes (extracted groundwater must be handled in accordance with all laws and as described in a site management plan); (2) require evaluation and potential installation of engineering controls ~~vapor barriers~~ if new non-commercial buildings are constructed ~~or~~, the current land use of existing buildings changes, ~~or the land use of existing buildings exceeds 8 hours per day (up to this exposure frequency, the risk to future commercial/ industrial workers is within the risk threshold)~~; and (3) prohibit residential use, unless appropriate engineering controls are implemented that are protective of residential receptors.
- A LUC RD report will be developed to specify the IC implementation actions and the roles and responsibilities for implementing, monitoring, and enforcing the ICs. The LUC RD would include: (1) the duration of the ICs; (2) the mechanisms that would be used to implement ICs and achieve the IC objectives; and (3) implementation actions necessary to ensure that the ICs and IC objectives are met, including inspecting, monitoring, reporting and enforcing the ICs.
- A site management plan will be developed that will specify the characterization, handling, and disposal requirements in the event that contaminated media are encountered during site redevelopment or maintenance activities. ~~ICs to prevent: (1) migration of contamination, including proper abandonment of any wells in the vicinity of the chlorinated ethenes groundwater plume that could provide a conduit for contaminant migration beyond the boundary of the plume; and (2) effects on water quality and risk to human health and the environment.~~ The site management plan will be enforced through the deed restriction.
- Five-year reviews and reporting will be conducted to ensure the continued effectiveness of the ICs.

The Navy has determined that it will rely on proprietary controls in the form of environmental restrictive covenants as provided in the “Memorandum of Agreement [MOA] between the United States Department of the Navy and the California Department of Toxic Substances Control” and associated covenant models (the “Navy/DTSC MOA”).

More specifically, land use and activity restrictions will be incorporated into two separate legal instruments as provided in the Navy/DTSC MOA:

1. Restrictive covenants included in one or more Quitclaim Deeds from the Navy to the property recipient.
2. Restrictive covenants included in one or more "Covenant to Restrict Use of Property" (CRUP) entered into by the Navy and DTSC as provided in the Navy/DTSC MOA and consistent with the substantive provisions of California Code of Regulations title 22 § 67391.1.

The CRUP will incorporate the land use restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The Quitclaim Deed(s) will include the identical land use and activity restrictions in environmental restrictive covenants that run with the land and that will be enforceable by the Navy against future transferees.

The Navy is responsible for implementing, maintaining, reporting, and enforcing land use controls. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity.

Future landowner may be permitted to develop Site 21 to residential uses by implementing engineering controls and maintaining those controls, to the extent necessary, to prevent exposure of future residents from inhalation of VOCs in groundwater through vapor intrusion to indoor air. Prior to residential redevelopment, a vapor intrusion mitigation work plan, that includes further details of the engineering controls and measures to protect future residents on site, will be prepared by future landowners for approval by the regulatory agencies. Alternatively, if in the future, contaminant concentrations are shown to have been reduced to levels where land use controls are not needed, a future land owner may remove or modify the CRUP with approval of DTSC.

### 2.11.3 Expected Outcomes of the Selected Remedy

The selected remedy will be protective of human health and the environment by preventing exposure to vapors in indoor air that may migrate from chlorinated ethenes present in groundwater and requiring proper management of contaminated groundwater. ~~by prohibiting: (1) future residential reuse unless appropriate engineering controls are implemented, and (2) groundwater use and groundwater extraction.~~ Once the selected remedy has been implemented, potential risks to human health ~~under~~ the environment under the likelyplanned future use will be controlled~~acceptable, and the RAOs will be achieved.~~

The selected remedy will allow Site 21 to be redeveloped and used in a manner consistent with the local reuse plan, subject to enforcement of appropriate controls for protection of future commercial/industrial workers and future residents. The selected remedy will require approximately 1 year to implement and will be followed by long-term site monitoring.

### 2.11.4 Statutory Determinations

In accordance with the NCP, the selected remedy meets the following statutory determinations.

- **Protection of Human Health and the Environment** – The selected remedy will protect human health and the environment by preventing exposure to chlorinated ethenes in groundwater.
- **Compliance with ARARs** – The selected remedy will meet all ARARs. The ARARs that will be met by the preferred alternatives are summarized in [Attachment A](#).
- **Cost-Effectiveness** – The selected remedy would provide overall protectiveness proportional to their costs and are considered cost-effective.
- **Utilization of Permanent Solution and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The selected remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a cost-effective manner at Site 21. Of all the alternatives that are protective of human health and the environment and comply with ARARs, the Navy has concluded that the selected remedy would provide the best balance of tradeoffs among short-term effectiveness, long-term effectiveness and permanence, implementability, and cost. The selected remedy is expected to be permanent and effective over the long-term land use.
- **Preference for Treatment as a Principal Element** – The selected remedy for Site 21 does not satisfy the statutory preference for treatment as a principal element of the remedy because active remediation is not required to meet remedial goals.
- **Five-Year Review Requirements** – Because the selected remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will follow the schedule of the on-going site-wide 5-year review to ensure the remedy is protective of human health and the environment.

## 2.12 COMMUNITY PARTICIPATION

Community participation at NAVSTA TI includes a Restoration Advisory Board (RAB), public meetings, public information repositories, newsletters and fact sheets, public notices, and an IR Program website. The May 2008 [Final Community Relations Plan<sup>\(24\)</sup>](#) for NAVSTA TI provides detailed information on community participation for the IR Program and documents interests, issues, and concerns raised by the community regarding ongoing investigation and cleanup activities at Former NAVSTA TI.

RAB meetings are held on a regular basis throughout the year and are open to the public to provided opportunity for public comment and input. Documents and relevant information relied on during the remedy selection process are made available for public review in the information repositories listed below or on the [IR Program website<sup>\(25\)</sup>](#) ([www.bracpmo.navy.mil](http://www.bracpmo.navy.mil))

### **San Francisco Public Library**

Government Publications Section  
100 Larkin Street  
San Francisco, California 94102  
Phone: (415) 557-4400

### **Navy BRAC Caretaker Support Office**

1 Avenue of the Palms, Suite 161  
Treasure Island  
San Francisco, California 94130  
(415) 743-4729

For access to the Administrative Record or additional information on the IR Program contact:

Ms. Diane Silva, Command Records Manager  
NAVFAC Southwest DIV Code EV33  
NSDB Building 3519  
1220 Pacific Highway  
San Diego, California 92132  
Phone: (619) 556-1280  
[diane.silva@nav.mil](mailto:diane.silva@nav.mil)

For additional information on the IR Program, contact:

James Sullivan  
BRAC Environmental Coordinator  
BRAC Program Management Office West  
1455 Frazee Road, Suite 900  
San Diego, California 92108-4310  
(619) 532-0966  
[james.b.sullivan2@navy.mil](mailto:james.b.sullivan2@navy.mil)

In accordance with CERCLA §§ 113 and 117, the Navy provided a public comment period from October 14, 2011, to November 14, 2011, for the proposed remedial action described in the Proposed Plan/Draft RAP for Site 21. A public meeting to present the Proposed Plan/Draft RAP was held from 6:30 to 8:30 p.m. on November 2, 2011. Public notice of the meeting and availability of documents appeared in the *San Francisco Chronicle* on October 14, 2011. Attachment E includes the public meeting notice and the transcript of the public meeting which includes a list of attendees.

### 3. RESPONSIVENESS SUMMARY

The purpose of the responsiveness summary is to summarize information about the views of the public and support agencies on both the remedial alternatives and general concerns about the site submitted during the public comment period. The responsiveness summary documents in the public record how public comments were integrated into the decision-making process.

The participants in the public meeting held on November 2, 2011, included community members, RAB members, and representatives of the Navy, DTSC, and the Water Board. Questions and concerns received during the meeting were addressed at the meeting and are documented in the meeting transcript ([Attachment E](#)). Responses to comments provided at the meeting and received during the public comment period are included in the responsiveness summary ([Attachment B](#)).

~~In compliance with the California Environmental Quality Act, DTSC prepared a Notice of Exemption (NOE) having determined that the proposed project for Institutional Controls has no potential for a significant impact on the environment. The NOE was made available for review and comment during the public comment period on the Proposed Plan/Draft RAP. No comments were received on the NOE. DTSC prepared an Initial Study to evaluate potential impact of the proposed project on the environment in accordance with the California Environmental Quality Act (CEQA). The findings of the Initial Study indicate that the project would not have a significant effect on public health or the environment. Therefore, DTSC prepared a proposed Negative Declaration for the Site 21 remedy. Both the Initial Study and proposed Negative Declaration were made available for review and comment during the public comment period. No comments were received during the comment period.~~

**ATTACHMENT A**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

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**ATTACHMENT B**  
**RESPONSIVENESS SUMMARY**

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**ATTACHMENT C**  
**REFERENCES**

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**(Reference Documents Provided on CD Only)**



**ATTACHMENT D**  
**ADMINISTRATIVE RECORD INDEX**

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**(Administrative Record Provided on CD Only )**

**ATTACHMENT E**  
**PUBLIC MEETING NOTICE AND PUBLIC MEETING TRANSCRIPT**

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**ATTACHMENT F**  
**STATEMENT OF REASONS**

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ATTACHMENT G  
PROPOSED PLAN/DRAFT RAP

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